

had not given satisfaction, and that at considerable expense iron axles were to be substituted for them. Our contemporary observes that questions have, naturally enough, been asked, and publishes Sir A. M. Rendel's reply:—"I originally," he says, "recommended the use of steel for axles on the Bombay, Baroda, and Central India metre gauge, because I thought that steel was not only better than iron, but because its price was not more than half that of the class of iron suited for axles. I was further moved to do so by an opinion that, whilst steel was improving in quality, and daily taking the place of the best classes of iron, the quality of those classes of iron must deteriorate, because the price obtainable for them must diminish. In respect to the relative price of steel and iron, I was quite right; in respect to their relative suitability for axles, I have been wrong, or, at any rate, premature. *Commercial steel, when used in axles, seems subject to deterioration, which makes it very brittle after a few years' wear.* The consequence is that we must do now what we should certainly have done at first, had all the facts been then before us—I mean, we must substitute iron for steel. It being also desired that our waggon loads should be increased, it has been found necessary to increase the size of our axles, and their weight in iron is now 231 lbs., instead of 198 lbs. in steel; and their present cost is £2 6s., instead of about £1 2s. 6d. Had we originally supplied the large iron axles, capital would have been charged, for every such axle supplied, the sum of £2 6s. or thereabouts, instead of £1 2s. 6d., and I can see no reason why, because we attempted an economy in the first instance, which experience has proved to be impracticable, capital should escape the larger charge now. It appears to me indisputable that the difference between the cost of the axles originally supplied and those now sent out should be charged to capital and not to revenue." The italics in this quotation are those of the *Engineer*, and the statement is a grave charge against steel, and one that the steel manufacturers will no doubt combat strongly. The *Engineer* does not tell us where these metre gauge axles have usually failed, and it is therefore difficult to find a reason for the wholesale rejection of steel as a suitable material for axles, always bearing in mind the general use of this material in this country for that purpose, with the greater mileage run with steel axles, be they crank or straight axles, over that obtainable from iron axles. It is to be hoped that the matter will be thoroughly thrashed out. The question of manufacture must not be overlooked. Steel rails occasionally fail at the ends owing to insufficient "crop" being cut off the rolled rail, *i.e.* the steel is not considered sound for about 3 feet from each end of the rail as it leaves the rolls, and is therefore usually rejected as "crop ends." If these axles are rolled ones, probably this might explain the failures, if they usually took place at the ends and not in the middles.

THE autumn series of science lectures at the Royal Victoria Hall began on Tuesday with a lecture on "Nebulæ," by Mr. J. D. McClure. The arrangements for lectures during the month of October are as follows:—October 7, "The Sun," by J. D. McClure; October 14, "Bees as Florists and Fruit Producers," by Rev. Prof. Cheshire; October 21, "The Colours of Animals and their Uses," by Dr. W. D. Halliburton; October 28, "Mountaineering," by H. G. Willink.

THE additions to the Zoological Society's Gardens during the past week include a Brown Bear (*Ursus arctos* ♂) from Russia, presented by Mr. G. W. Robinson; a Golden Eagle (*Aquila chrysaetus* ♀) from the Rocky Mountains, Wyoming, U.S.A., presented by Mr. Percy Cooper; two Common Squirrels (*Sciurus vulgaris*), British, a Reticulated Python (*Python reticulata*) from Siam, purchased; five Viperine Snakes (*Tropidonotus viperinus*), born in the Gardens.

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OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on October 2 = 22h. 46m. 16s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 4827	—	—	22 36 13	+60 42
(2) G.C. 4883	—	—	22 55 43	+29 33
(3) β Pegasi	2	Yellowish-red.	22 58 12	+27 29
(4) π Aquarii	5	Yellowish-white.	22 19 42	+0 49
(5) η Aquarii	4	White.	22 29 42	-0 47
(6) α Pegasi	2	White.	22 59 18	+14 37
(7) 257 Schj.	9	Reddish-yellow.	21 51 9	+49 59

Remarks.

(1) In the spectrum of this nebula Dr. Huggins has recorded only the chief nebula line near λ 500. It is remarkable that Herschel describes it as easily resolvable, and if this be correct the nebula must be regarded as a cluster of nebulous stars. This important result is well worth checking, both by telescopic and spectroscopic observations.

(2) This nebula is described as "considerably bright; considerably large; little elongated; gradually much brighter in the middle; mottled as if with stars." The spectrum of the nebula is rather vaguely described by Dr. Huggins as follows: "The spectrum does not consist of one or two lines only; I believe it is continuous." The doubt should be removed by a more definite observation.

(3) The spectrum of this star is a very fine one of Group II. The dark bands, however, are by no means so strongly developed as they are in α Herculis or Mira, but still they are well marked, and, in addition, the spectrum abounds with lines. The relative feebleness of the bands, and the presence of so many lines, indicates that the star is well advanced in condensation, and this is further confirmed by my own observation of the comparatively feeble bright flutings of carbon. Most of the lines are identical with those seen in Aldebaran. D is partly hidden by a dark fluting, but lines in other places stand out prominently. They are not quite like those seen in the solar spectrum, and hence the spectrum of the star is one from which useful information relative to the criteria between Groups III. and V. may be derived.

(4) Prof. Pickering has found by photography that the spectrum of this star contains bright lines. Vogel, however, describes the spectrum as a well-marked one of the solar type, and makes no mention of bright lines. In my own observations of the star I found the dark lines characteristic of the spectrum of a star like the sun, but detected no bright ones. It is quite possible, therefore, that the bright lines are not always visible, and the spectrum should be examined with reference to a possible periodicity.

(5) According to the observations of Konkoly, this star has a well-marked spectrum of the solar type, but Gothard and Vogel describe it as one of Group IV. My own observations confirm those of Vogel.

(6) A star of Group IV.

(7) This faint star has a spectrum of Group VI., and Dunér states that the dark carbon band which separates the green and yellow zones is wider than he has seen it in any other star. The blue zone is scarcely perceptible. It seems as if this is a star which has cooled down until it is almost non-luminous, and the observation is important as indicating to a certain extent what the spectrum will be at the last stage of visibility. It appears that the carbon absorption intensifies until finally all the remaining light is absorbed.

A. FOWLER.

THE TELLURIC SPECTRUM.—The current number of *Comptes rendus* (September 22) contains an account of the expedition lately made to the summit of Mont Blanc by M. Janssen, for the purpose of observing the spectrum of the sun from an elevated station. Two years ago M. Janssen ascended Mont Blanc as far as the Grands-Mulets, a station having an altitude of 3050 metres. The spectroscopic observations then made showed that a diminution took place in the intensity of the groups of lines A, B, and a, due to the action of the oxygen in the atmosphere, and indicated very definitely that at the limits of our atmosphere these groups would disappear. To confirm these results it was resolved this year to repeat the observations at a greater elevation,

and after considerable difficulties the Cabane des Bosses was reached on August 18. The altitude of this station is 4400 metres. Work was commenced four days later, and precisely similar results obtained. The B group, which appears to consist of ten well-defined doubles when observed at Meudon, and was almost reduced to the last double at Grands-Mulets, had disappeared altogether.

These observations, in conjunction with those made last year between the Eiffel Tower and Meudon, those made by M. de la Baume Pluvinel at Candia during the annular eclipse of June 17, and those made in the laboratory at Meudon, definitely demonstrate the absence of oxygen from the sun, or, at least, of oxygen in the state that we know it.

M. Janssen thinks that, in the interests of astronomical and terrestrial physics and of meteorology, an Observatory should be established on the summit of Mont Blanc. The difficulties to be overcome in the erection of a station at such an elevation are great, but that they are not insurmountable is evidenced by the observations that have just been made.

ASTRONOMY AND NUMISMATICS.—Dr. A. Vercoût, in *L'Astronomie* for September, points out how astronomical knowledge may be of service to numismatical science. It is known that on many antique medals, and notably on the coins of the Roman Republic, stars and members of the solar system figure sometimes as symbols and sometimes as heraldic allusions to the magistrate by whom the coin was struck. Thus, on a coin struck by L. Lucretius Trio, 74 B.C., the seven stars in Ursa Major are shown, and this constellation, being named Septem Triones, was evidently used as a phonetic allusion to the surname (Trio) of the magistrate. Again, on a coin struck in B.C. 43, Dr. Vercoût noticed five stars, one of which was much larger than the others. He therefore concluded that the constellation represented on the coin was Taurus, as this was the only group of five stars known to the ancients in which one was more brilliant than the others. On this account he was enabled to attribute the coin to P. Clodius Turrinus, who apparently used the constellation Taurus or Taurinus as a phonetic signification of his surname. A coin struck by Manius Aquillus, B.C. 94, has figured upon it the first four stars in the constellation Aquila. They are shown in nearly the same relative positions occupied in reality, hence the coin contains the oldest known representation of a portion of the celestial vault. It is therefore possible that an inspection of the stars figured on old coins may be the means of ascertaining the identity of the magistrate under whom they were struck, or, knowing this and the constellation represented, they may be useful for the determination of proper motion.

GEOGRAPHICAL NOTES.

M. ANDRUSOFF, whose researches into the geological history of the Caspian Sea have been mentioned more than once in *NATURE*, gives now some interesting preliminary results of his exploration of the Black Sea. After having carefully studied all that was previously known about that sea and embodied it in an excellent paper (published in the last issue of the *Izvestia* of the Russian Geographical Society, vol. xxvi., 2), he induced the Hydrographical Department of the Russian Navy to send out a special gunboat for the exploration of the Black Sea, under Captain Spindler and Captain Wrangel. The sea was thus carefully explored from Odessa to Constantinople, and thence to Batum and Sebastopol. It appears that great depths are found everywhere within a short distance of the shore; and that from a depth of 200 metres the water of the Black Sea begins to contain sulphuretted hydrogen resulting from the decomposition of decaying organisms, so that no organisms either vegetable or animal, are met with at depths exceeding 200 metres. The Black Sea, he concludes, is not a sea, properly speaking, but an immense stagnant pond (reaching a maximum depth of 1200 fathoms) which is covered on the surface by the water of the Mediterranean and the rivers which flow into it. The full report of M. Andrusoff is expected soon, and is sure to be full of interest.

A TELEGRAM, dated Tashkend, September 15, gives some extracts from a letter written by M. Grombchevsky on July 20, at Sel-kilian. The expedition had at last reached Tibet from the north; but the hostility of the ruler of Keria compelled them to undertake the journey too early in the spring. On May

21, they were on the Tibet plateau, but weather was most inclement at that time. Hard frosts (20° C. below zero), terrible snow-storms, and a complete want of water—the snow in the mountains not having yet begun to thaw—compelled the expedition to return to Kashgaria without having accomplished the proposed programme of exploration. Later on, the want of money prevented them from returning to Tibet in the summer. M. Grombchevsky also adds that the ruler of Kanjut has entered into vassal relations to the Government of India, and that the fort Shahidulla-hodja is occupied by a garrison of Kashmerees, thus commanding the drainage area of the Raskem-daria and its pasture grounds. Besides, in April last, the beck of Kanjut took possession of the Pamir and Dangarym-bash forts, formerly occupied by Chinese garrisons; so that the fort Pamir, which is now practically under English influence, and the Russian fort Kara-kul are separated by but a three days' march over a territory densely peopled with Kirghizes. We may thus expect that the veil which has for so many centuries concealed those regions from science will soon be entirely lifted, and Northern Tibet will become as well known as Central Asia.

"THE AGE OF SCIENCE."

ON Friday evening last, Lord Derby, before distributing the awards of the Liverpool School of Science, delivered a clear, vigorous, and interesting address on some aspects of science. Ours, he said, would be remembered as pre-eminently the age of science. Our successors might excel us as writers, as politicians, as soldiers; they might surpass even the industrial energies of the present time, but it was not likely—it was scarcely possible—that in the region of science the twentieth century should witness advances greater than, or as great as, those of the nineteenth. The general experience of the world had been that brilliant but brief epochs of advance had been followed by long intervals of stagnation, and sometimes even of retrogression. Retrogression was not likely, but stagnation was quite possible. There was one phrase much employed when people talked on these subjects which, to his mind, contained a fallacy. He meant the common phrase of popularizing science. To popularize science was simply impossible. Anybody could cram up, with the help of an average memory and of easily acquired hand-books, a summary of what had been done in astronomy, in chemistry, or other sciences, but when that result was accomplished he would be very little nearer to any real gain which science could bring to him. It was only labour and perseverance, added to natural capacity, that could give a scientific mind. Some tincture of scientific knowledge was desirable for every educated person. The result might not be great, but the process was valuable. An entire absence of the scientific spirit was no doubt compatible with brilliant talent and high distinction. We did not find fault for a deficiency of that kind in a novelist, a poet, or a writer of light literature, but it was a deficiency notwithstanding. If asked what he meant by a scientific spirit, he thought he knew, but he must confess that it was more easily described in vague and general terms than precisely defined. He meant by it, in the first place, a habit of accuracy and exactness in matters of fact. In the next place, he meant that temper of mind which seeks for conclusions, but does not jump at them—which is equally opposed to the stupid incredulity of ignorance, refusing to accept any idea which is not familiar; to the reverential credulity which accepts as true any statement coming down from old or high authority; and to the careless indifferentism which, so long as a theory looks and sounds well, and especially if it flatters some previously existing feeling of prejudice, does not care on what foundation of reality that theory rests. That the world is governed by laws which we did not make and cannot abolish—laws which will operate whether we recognize or ignore them, and which it is our wisdom therefore to study that we may obey, and in obeying utilize them—that was what was taken to be the outcome of scientific teaching, and if anybody thought that a useless or an unimportant or unnecessary lesson he did not agree with him. Something else science, rightly understood, would teach us to know—what it is that we can hope to know and to understand; and to recognize how little that is, and how much lies, and probably always will lie, beyond the reach of our faculties. One word only he would add—that, having known men of many professions, he should say, as far as his observation went, the happiest lives were those which had been devoted to science. "Every step," said Lord